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(54) **AGRICULTURAL DEVICE FOR REMOVING CROP REMNANTS**

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(51) **Int. Cl.**
A01D 34/835 (2006.01)

(52) **U.S. Cl.**
CPC ***A01D 34/8355*** (2013.01)

(58) **Field of Classification Search**
CPC A01D 25/04; A01D 25/044; A01D 25/00; A01D 33/00; A01D 34/8355; A01D 82/02
USPC 171/50, 53, 58
See application file for complete search history.

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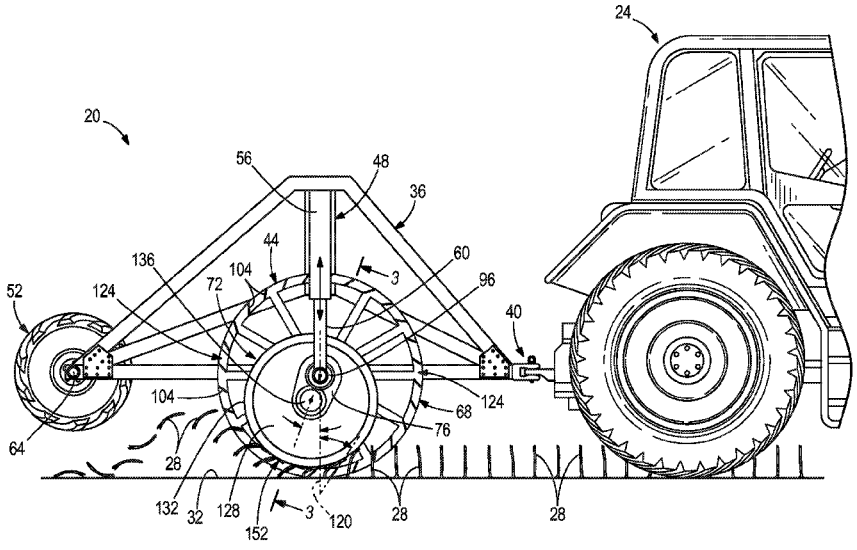
(57) **ABSTRACT**

Agricultural devices and methods of operating the same are provided. In one aspect, an agricultural device includes a frame including a hitch and a roller assembly coupled to the frame. The roller assembly includes an outer roller and an inner roller. The outer roller includes a pair of end plates and a plurality of spaced-apart engagement members extending between and coupled to the end plates. Each of the engagement members include an inner edge extending into the outer roller and the outer roller is rotatably coupled to the frame. The inner roller is positioned in the outer roller and includes a pair of end plates and an exterior surface extending between the end plates. The inner roller is rotatably coupled to the outer roller and the inner edges of the engagement members are adapted to be positioned proximate the exterior surface of the inner roller.

20 Claims, 7 Drawing Sheets



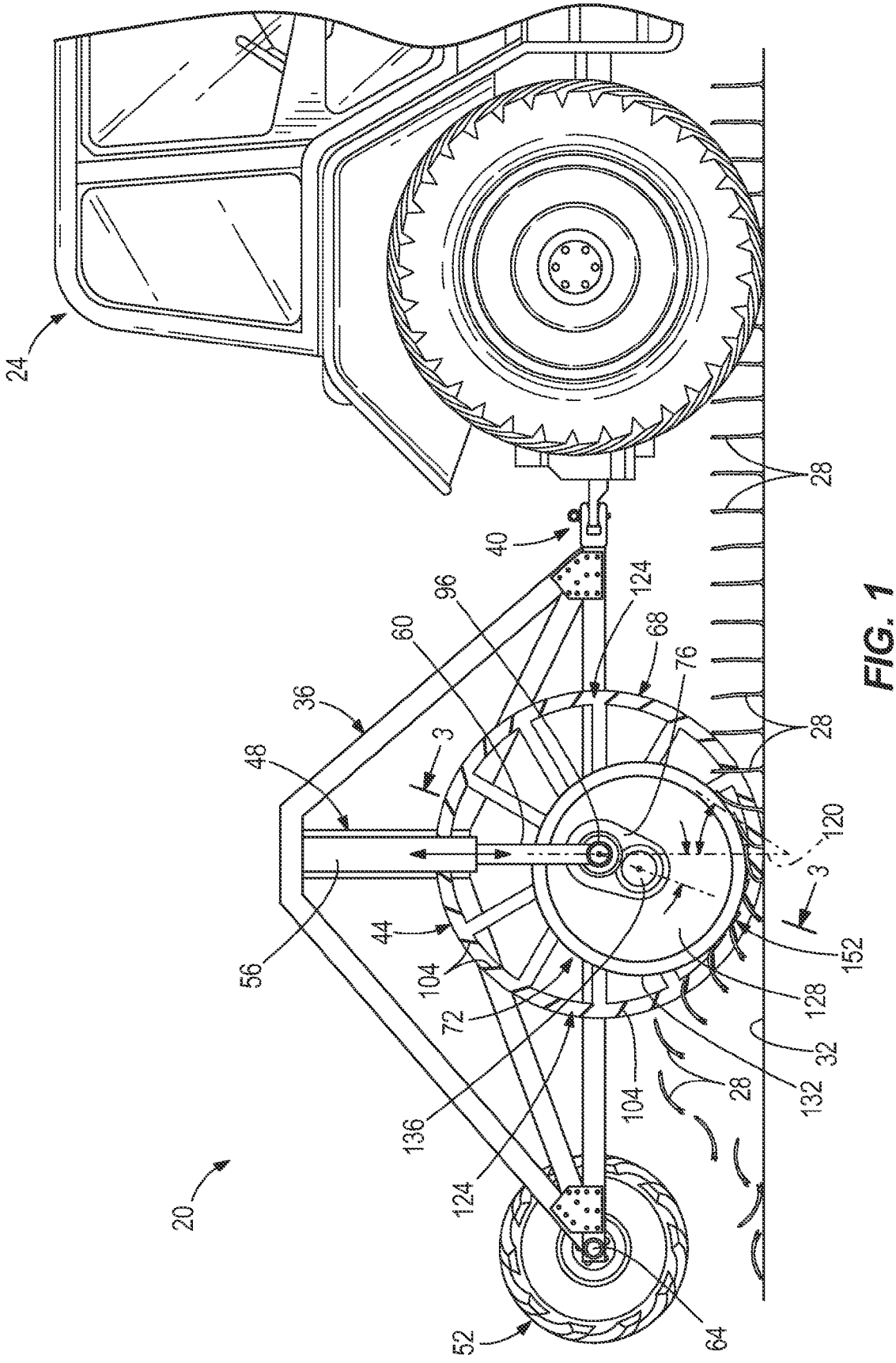

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FIG. 1

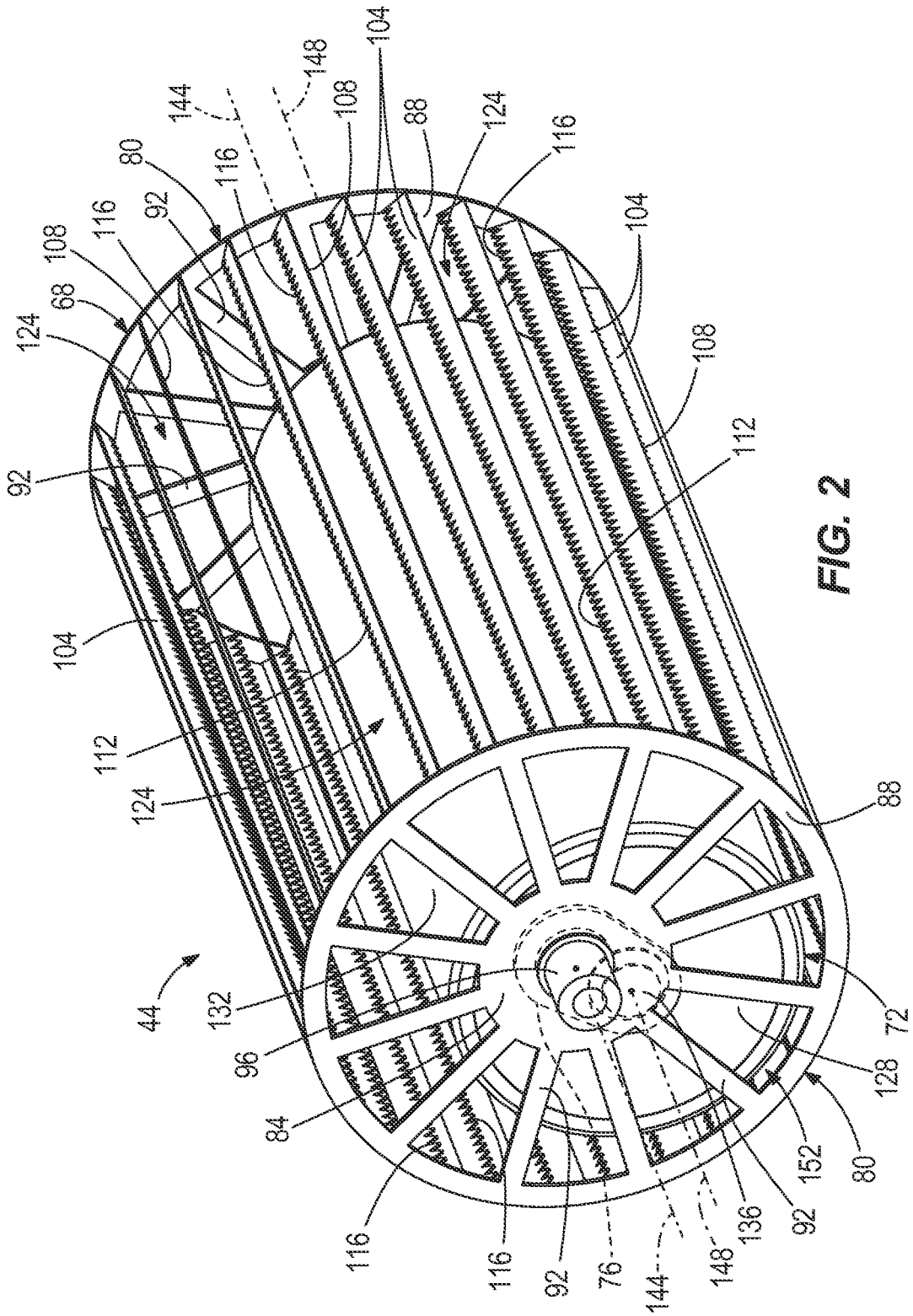
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FIG. 2

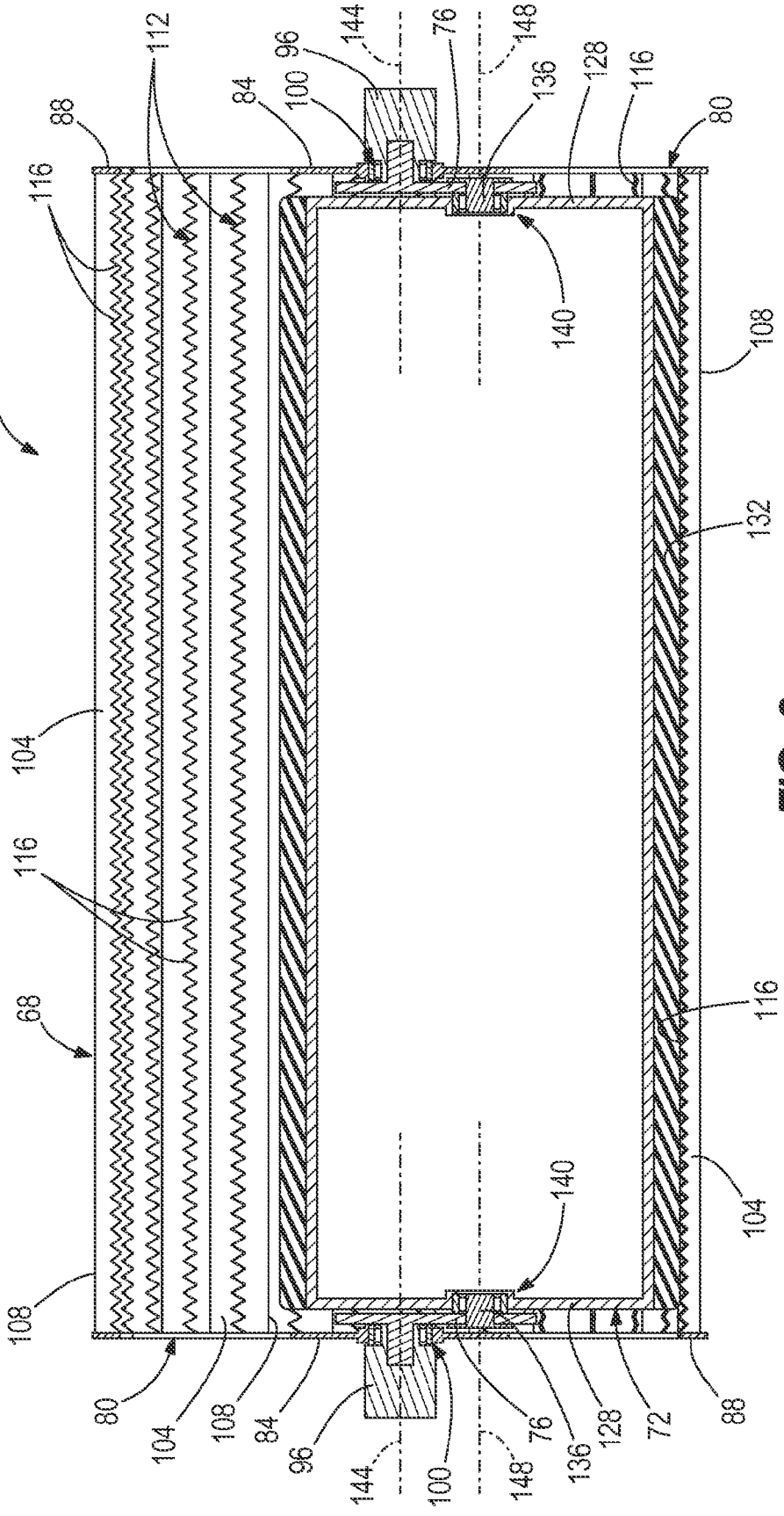

FIG. 3

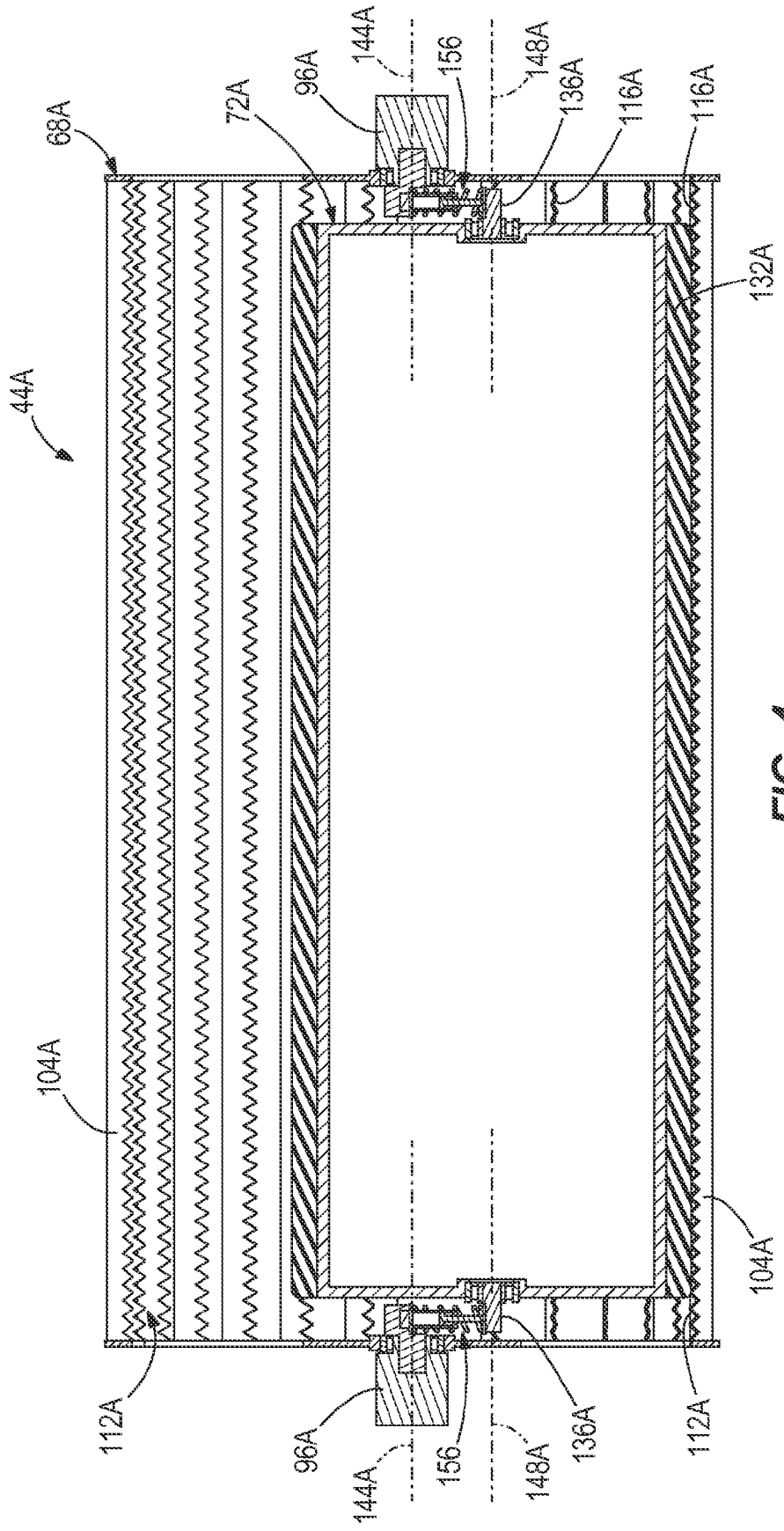
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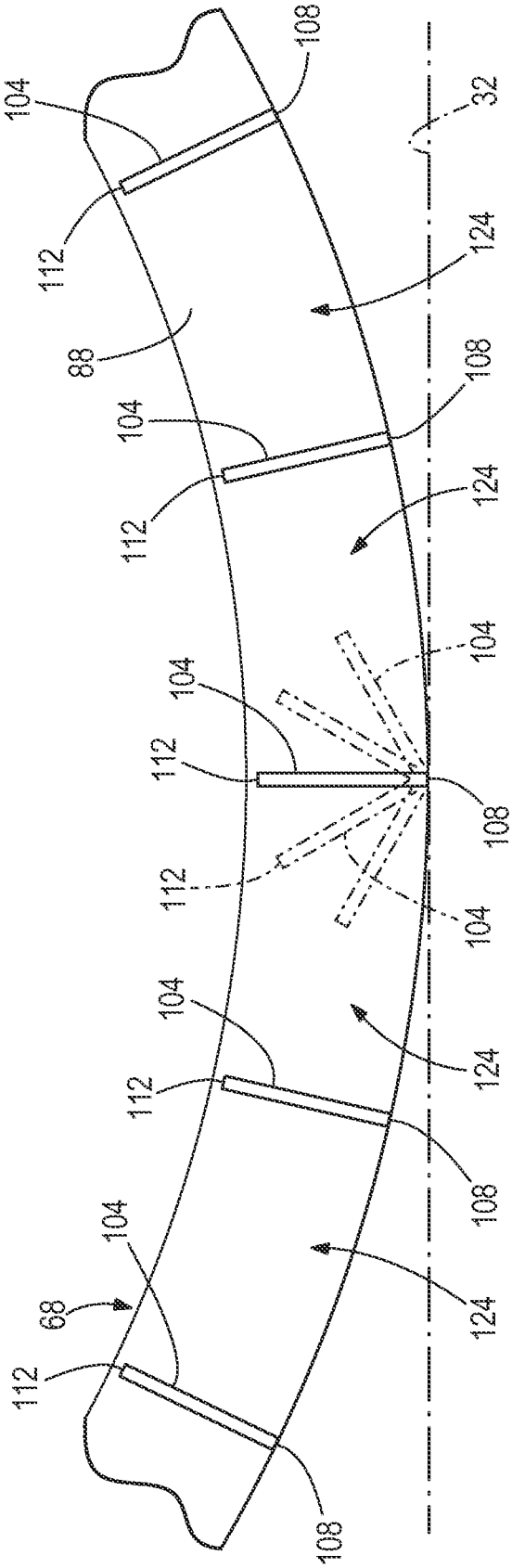
FIG. 4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68
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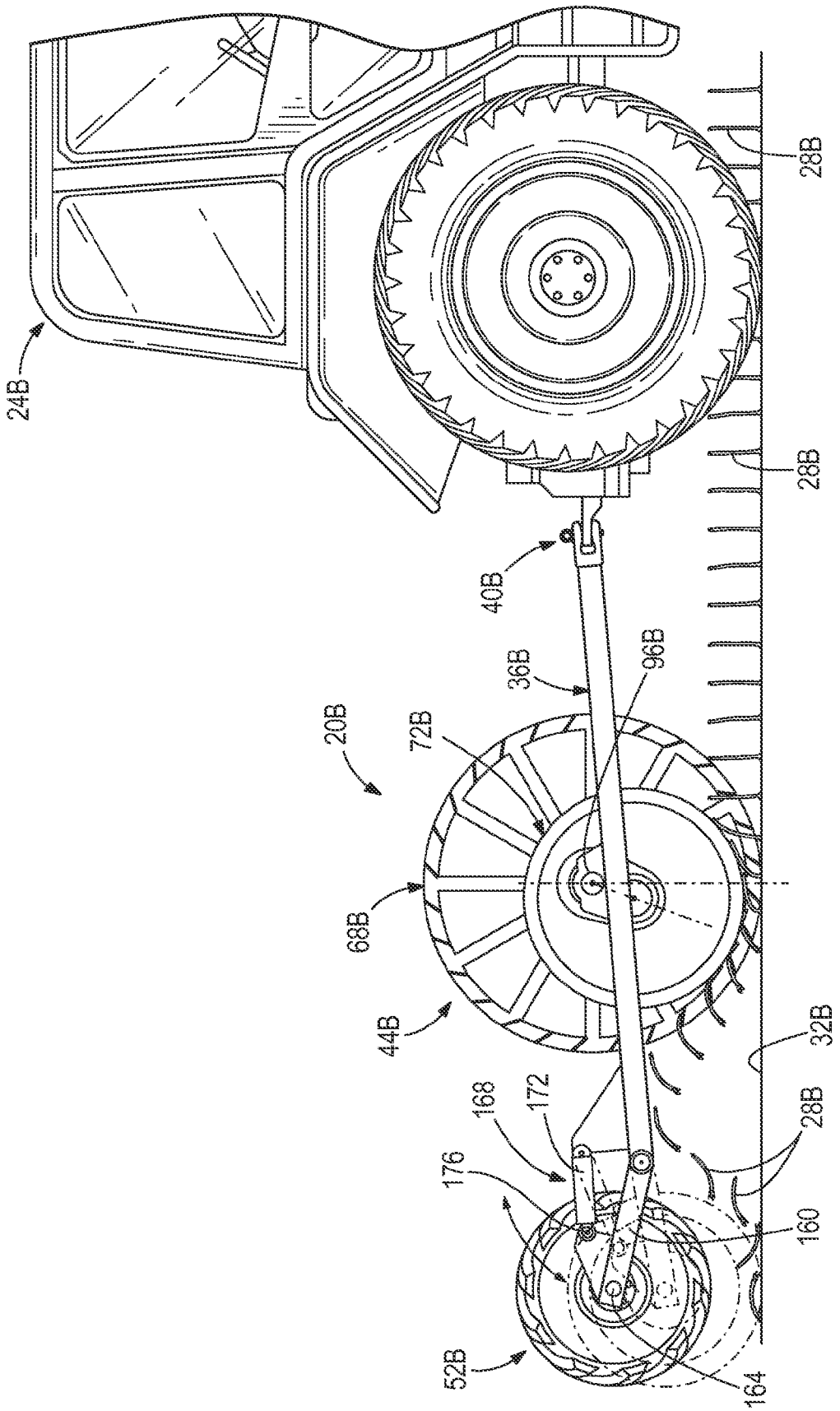
124
108

FIG. 5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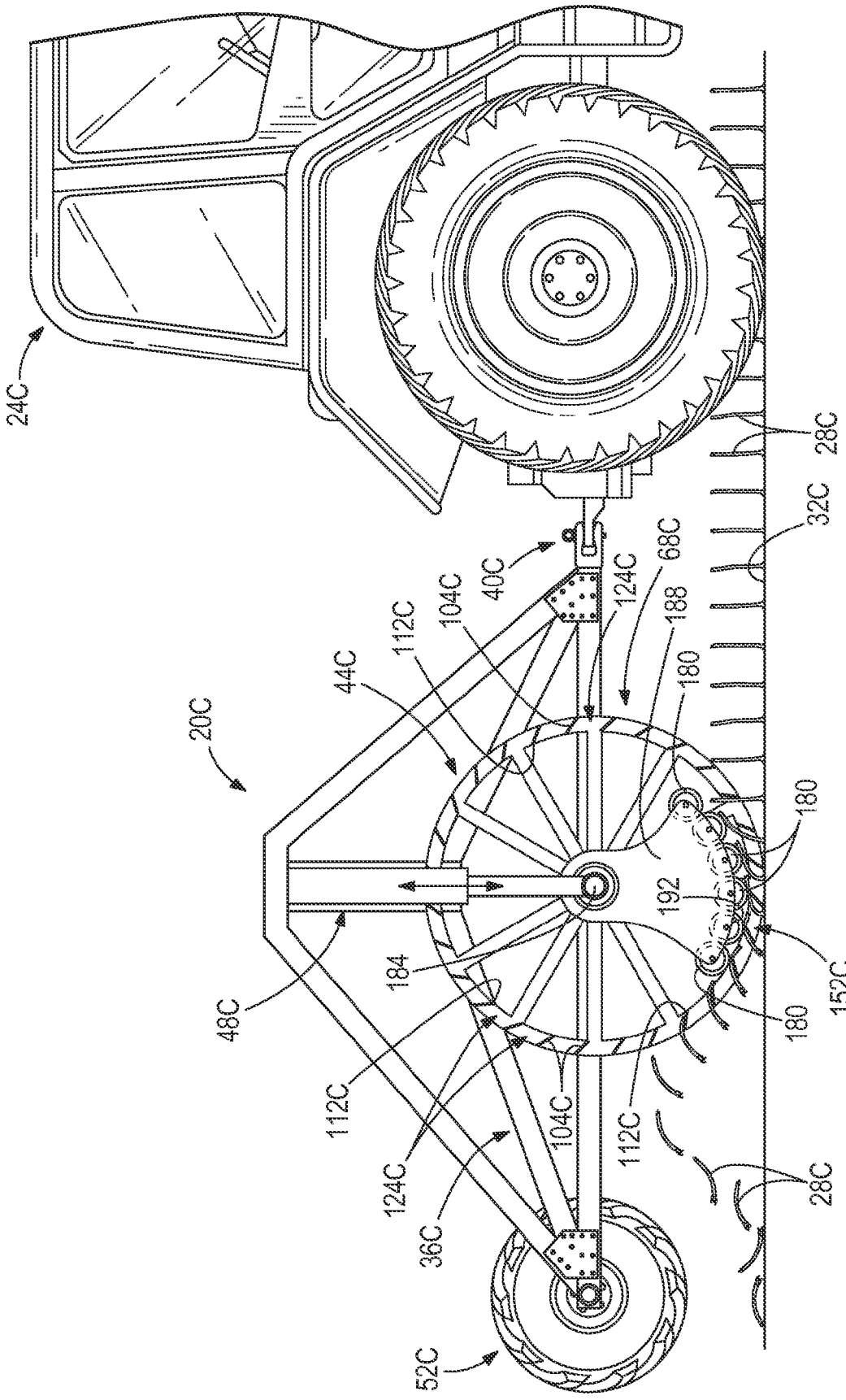
160
52B
164

FIG. 6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40C
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112C
44C
188
180
20C
180
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48C
184
180
112C
104C
112C
124C
28C
36C
52C

FIG. 7

AGRICULTURAL DEVICE FOR REMOVING CROP REMNANTS

RELATED APPLICATIONS

The present application claims the benefit of U.S. Provisional Patent Application No. 61/739,988, filed Dec. 20, 2012, the entire contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present disclosure generally relates to agricultural devices and, more particularly, to agricultural devices for removing crop remnants from soil.

BACKGROUND

Recently, no-till farming has become more popular. No-till farming requires that the soil remain untilled subsequent to harvesting of crops from the field. For example, a combine harvests corn from a field by cutting corn stalks a distance above the soil. No-till farming leaves the uncut portion of the corn stalks in the soil in order to achieve minimal soil disturbance. Some believe no-till farming has benefits and its adoption has grown steadily over the years. However, leaving remnant stalks in the soil after harvest have several deleterious effects.

One such deleterious effect is the damage the remaining un-cut stalks cause to tires of agricultural devices such as tractors, implements pulled behind tractors, etc. In some cases, remnant stalks accelerate the wear of tires. For example, tires may normally have a 5 or 6 year life when not exposed to remnant stalks. However, remnant stalks can decrease the life of a tire to 2 or 3 years. This decrease in life can be a substantial financial burden. Tires for agricultural devices can range from several hundreds of dollars to $5000 or even more, and many agricultural devices include numerous tires. As can be seen, tire costs are quite substantial and decreasing the life of a tire by 50% or more creates an added financial burden.

No-till farming can also decrease crop yield. Remnant crop stalks include the portion of the stalk above the soil and the root mass or root ball beneath the soil. When planting crops into the remnant crop stalks, the remnant stalks can create air pockets in a seed trench, cause shallow or inconsistent depth of seed placement, and/or poor seed-to-soil contact. All of these factors and others can delay plant emergence from the seed or may prohibit growth altogether, thereby greatly reducing crop yield.

SUMMARY

It is therefore desirable to provide an agricultural device that resolves one or more of the above-referenced and other deficiencies

In one aspect, an agricultural device is provided and includes a frame including a hitch and a roller assembly coupled to the frame. The roller assembly includes an inner roller and an outer roller. The outer roller includes a pair of end plates and a plurality of spaced-apart engagement members extending between and coupled to the end plates. Each of the engagement members includes an inner edge extending into the outer roller and the outer roller is rotatably coupled to the frame. The inner roller is positioned in the outer roller and includes a pair of end plates and an exterior surface extending between the end plates. The inner roller is rotatably coupled to the outer roller and the inner edges of the engagement members are adapted to be positioned proximate the exterior surface of the inner roller.

In one aspect, the inner edges of the engagement members are at least partially serrated.

In one aspect, the inner edges of the engagement members engage the exterior surface of the inner roller.

In one aspect, the inner edges of the engagement members engage the exterior surface of the inner roller toward a rear of the roller assembly.

In one aspect, the exterior surface of the inner roller is at least partially made of a resilient material.

In one aspect, the outer roller rotates about a first axis and the inner roller rotates about a second axis offset from the first axis.

In one aspect, the second axis is positioned below and to a rear of the first axis based on a direction of travel of the agricultural device.

In one aspect, the agricultural device further includes a lift mechanism coupled to the frame and the roller assembly to vertically move the roller assembly.

In one aspect, the lift mechanism moves the roller assembly between an operating position, in which the outer roller engages soil, and an inoperative position, in which the outer roller is positioned above and out of contact with the soil.

In one aspect, the agricultural device further includes a travel wheel rotatably coupled to the frame and adapted to engage a ground surface.

In one aspect, the agricultural device further includes a lift mechanism coupled to the travel wheel to move the travel wheel vertically into and out of contact with a ground surface.

In one aspect, an agricultural device is provided and includes a frame including a hitch, and a roller assembly coupled to the frame. The roller assembly includes a first roller defining an internal cavity and including at least one engagement member. The engagement member includes an inner edge extending into the internal cavity of the first roller, and the first roller has a first diameter and is rotatably coupled to the frame. The roller assembly also includes a second roller at least partially positioned in the internal cavity of the first roller and includes an exterior surface. The first roller is rotatably coupled to the second roller and the inner edge of the engagement member is adapted to be positioned proximate the exterior surface of the second roller. The second roller has a second diameter smaller than the first diameter.

In one aspect, the first roller includes a plurality of engagement members and each of the plurality of engagement members include an inner edge, and wherein inner edges of the plurality of engagement members are adapted to be positioned proximate the exterior surface of the second roller.

In one aspect, the inner edge of the engagement member is at least partially serrated.

In one aspect, the inner edge of the engagement member engages the exterior surface of the second roller.

In one aspect, the inner edge of the engagement member engages the exterior surface of the second roller toward a rear of the roller assembly.

In one aspect, the exterior surface of the second roller is at least partially made of a resilient material.

In one aspect, the first roller rotates about a first axis and the second roller rotates about a second axis offset from the first axis.

In one aspect, the second axis is positioned below and to a rear of the first axis based on a direction of travel of the agricultural device.

In one aspect, the second roller is one of a plurality of second rollers, wherein each of the plurality of second rollers

include an exterior surface that is adapted to be positioned proximate the inner edge of the engagement member.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosure can be better understood with reference to the following drawings and description. The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the disclosure.

FIG. **1** is an elevational view of an exemplary agricultural device including principles of the disclosure, the agricultural device is being pulled by an exemplary tractor, in accordance with one embodiment.

FIG. **2** is a top front perspective view of an exemplary roller assembly of the agricultural device illustrated in FIG. **1**, in accordance with one embodiment.

FIG. **3** is a cross-sectional view taken along line **3-3** in FIG. **1**, in accordance with one embodiment.

FIG. **4** is a cross-sectional view similar to FIG. **3** showing another exemplary roller assembly, in accordance with one embodiment.

FIG. **5** is an elevational view of a portion of the roller assembly illustrated in FIG. **2**, the portion of the roller assembly shows numerous embodiments and orientations of engagement members of the roller assembly, in accordance with one embodiment.

FIG. **6** is an elevational view of another exemplary agricultural device including principles of the disclosure, the agricultural device is being pulled by an exemplary tractor, in accordance with one embodiment.

FIG. **7** is an elevational view of a further exemplary agricultural device including principles of the disclosure, the agricultural device is being pulled by an exemplary tractor, in accordance with one embodiment.

DETAILED DESCRIPTION

With reference to FIG. **1**, an exemplary embodiment of an agricultural device **20** is illustrated. An exemplary tractor **24** for pulling the agricultural device **20** is also illustrated. The agricultural device **20** is adapted to remove or pull un-cut, remnant crop stalks **28** (including both the portion above the soil and the root mass or root ball beneath the soil) from the soil **32** in an agricultural crop field. Such remnant stalks **28** are left behind after the crop is harvested from a field. Moreover, the agricultural device **20** is adapted to remove the remnant crop stalks **28** in a relatively gentle manner with minimal disturbance to the soil **32**. The agricultural device **20** crushes, splinters, punctures, or otherwise deteriorates the remnant stalks **28** to accelerate decomposition of the remnant stalks **28**. The agricultural device may be used to remove remnant stalks associated with a wide variety of crops and all of such crop possibilities are intended to be within the spirit and scope of the present disclosure. One example of a crop includes corn.

In the illustrated exemplary embodiment, a single agricultural device **20** is pulled behind a tractor **24** after a crop has been harvested from the crop field. In other exemplary embodiments, the agricultural device **20** may be pulled behind a harvesting device, such as, for example, a combine, during the harvesting process. In this alternative embodiment, the crop field is traversed only a single time to perform both harvesting and removal of remnant crop stalks **28**. In yet other alternative embodiments, a plurality of agricultural devices **20** may be pulled behind a tractor or behind a harvesting device.

Returning to the illustrated exemplary embodiment, the agricultural device **20** includes a frame **36** including a hitch or coupling member **40** for coupling to the tractor **24**, a roller assembly **44** coupled to the frame **36**, a lift mechanism **48** coupled to the roller assembly **44** for vertically moving the roller assembly **44**, and a travel wheel **52** adapted to selectively engage a ground surface (e.g., soil, roadway, etc.) when the agricultural device **20** is not operating.

The frame **36** can have a variety of configurations. In the illustrated exemplary embodiment, the frame **36** includes the hitch **40** at a front thereof and the travel wheel **52** at the rear thereof. The lift mechanism **48** is coupled to and supported by the frame **36** between the hitch **40** and the travel wheel **52**. The lift mechanism **48** can be a wide variety of different types of mechanisms adapted to vertically move the roller assembly **44**. In the illustrated exemplary embodiment, the lift mechanism **48** includes a lift housing **56**, and a coupling arm **60** coupled to the roller assembly **44** and moveable within and along the lift housing **56**. The coupling arm **60** may be powered in a variety of different manners, all of which are intended to be within the spirit and scope of the present disclosure. For example, the coupling arm **60** may be powered for movement by hydraulics, pneumatics, screw drive, or any other type of power capable of moving the coupling arm **60** relative to the lift housing **56**.

The lift mechanism **48** is adapted to move the roller assembly **44** from an operating position, in which the roller assembly **44** engages the soil **32** and removes the remnant stalks **28**, to a travel position, in which the roller assembly **44** is moved upward out of engagement with the soil **32** to a height where a bottom of the roller assembly **44** is positioned above a bottom of the travel wheel **52** to enable engagement of the travel wheel **52** with the soil **32** or other ground surface. Alternatively, in the operating position of the roller assembly **44**, the roller assembly **44** may be spaced above the soil **32** and engage the remnant stalks **28**. When the roller assembly **44** is not is use and/or is traveling on surfaces other than crop fields, it may be desirable to have the travel wheel **52** contact the ground surface instead of the roller assembly **44**. This inhibits the roller assembly **44** from prematurely wearing out or being damaged. The travel wheel **52** is coupled to the frame **36** via a travel wheel axle **64**. In the illustrated exemplary embodiment, the device **20** includes a single travel wheel **52**. In other embodiments, the device **20** includes a plurality of travel wheels **52** and can include a single travel wheel axle **64** to accommodate the plurality of travel wheels **52** or multiple axles **64** to accommodate the plurality of travel wheels **52**.

With continued reference to FIG. **1** and additional reference to FIGS. **2** and **3**, the roller assembly **44** includes an outer roller **68**, an inner roller **72**, and a coupling member **76** to couple the outer and inner rollers **68**, **72** together. The outer roller **68** is larger in diameter than the inner roller **72**. In some exemplary embodiments, the outer roller **68** can be between about 48 inches and about 60 inches in diameter and the inner roller **72** can be between about 50% and about 90% the size of the outer roller **68**. Alternatively, the outer roller **68** and the inner roller **72** can have any size and be within the intended spirit and scope of the present disclosure.

The outer roller **68** includes a pair of end plates **80** with each end plate **80** including a hub **84**, a circumferential portion or outer portion **88**, and a plurality of spokes or radial support members **92** extending between the hub **84** and the outer portion **88** of the end plate **80**. The outer roller **68** is rotatably coupled to the frame **36** via an outer roller axle **96** coupled to the hubs **84** of the two end plates **80**. A bearing assembly **100** is positioned between the outer roller axle **96**

and each end plate **80** to facilitate rotation of the end plates **80** relative to the outer roller axle **96**.

The outer roller **68** also includes a plurality of engagement members **104** extending between and coupled at their ends to the outer portions **88** of the end plates **80**. In the illustrated exemplary embodiment, each engagement member **104** includes an outer edge **108** that is relatively flat and smooth, and an inner edge **112** that is serrated to provide a plurality of teeth **116** having a generally triangular shape. Alternatively, the inner edge **112** may also be flat and smooth, or the inner edge **112** may include teeth **116** having a different shape such as, for example, pyramid, conical, frusto-conical, semi-circular, semi-spherical, or any other polygonal or arcuately perimetered tooth shape. The engagement members **104** are also angled or raked forward. In the illustrated exemplary embodiment, the engagement members **104** are angled forward at about a 30 degree angle relative to a vertical plane **120** (see FIG. **1**). Alternatively, and with reference to FIG. **5**, the engagement members **104** may be oriented at different angles relative to the vertical plane **120**. For example, the engagement members **104** may be angled or raked forward, angled or raked rearward, or may be vertically oriented (i.e., parallel to the vertical plane or radially aligned with or extending through a center of the outer roller). The engagement members **104** may be angled forward or rearward at any angle. For example, the engagement members **104** may be raked forward or rearward at about a 45-degree angle relative to the vertical plane **120** or they may be raked forward or rearward at about a 60-degree angle relative to the vertical plane **120**. It should be understood that the engagement member **104** may be at any orientation relative to the vertical plane **120** and be within the intended spirit and scope of the present disclosure.

Referring back to FIGS. **1-3**, the engagement members **104** are spaced-apart from each other to provide an opening **124** between each pair of engagement members **104**. The openings **124** are adapted to receive the remnant stalks **28** during operation of the device **20**. The engagement members **104** may be spaced-apart from each other at any distance. In some exemplary embodiments, the engagement members **104** may be spaced-apart about 8 inches. Alternatively, the engagement members **104** may be spaced-apart from each other between about 1 inch and about 36 inches or more.

The inner roller **72** is positioned within the outer roller **68** and includes a pair of end plates **128** and an exterior surface **132** extending between the end plates **128**. The exterior surface **132** is adapted to engage or be positioned in close proximity to the inner edges **112** of the engagement members **104**. The position of the inner roller **72** may be adjusted as desired to accommodate crop field conditions, treatment of the remnant crop stalks **28**, and/or wear of the components of the roller assembly **44**. The exterior surface **132** may be comprised of a resilient material adapted to accommodate contact with the inner edges **112** of the engagement members **104** and/or contact with the remnant stalks **28** during operation of the device **20**. The resilient exterior surface **132** also inhibits binding of the two rollers **68**, **72**, and premature wearing of the exterior surface **132** of the inner roller **72** and the inner edges **112** or teeth **116** of the engagement members **104**. The exterior surface **132** may be comprised of any resilient material such as, for example, rubber, plastic (hard or soft), etc.

The inner roller **72** is rotatably coupled to the outer roller **68** via the coupling member **76**. In the illustrated exemplary embodiment, an inner roller axle **136** is coupled to the end plates **128** of the inner roller **72** and a bearing assembly **140** is positioned between the inner roller axle **136** and each end plate **128** to facilitate rotation of the inner roller **72** relative to the inner roller axle **136**. The outer roller axle **96** and the inner roller axle **136** are coupled to a coupling member **76** at each end thereof. The outer roller axle **96** rotates about a first generally horizontal axis **144** and the inner roller axle **136** rotates about a second generally horizontal axis **148**. In the illustrated exemplary embodiment, the second axis **148** is offset from the first axis **144** below and to a rear of the first axis **144**. The second axis **148** may be offset to a rear of the first axis **144** by between about 1 degree to about 45 degrees relative to the vertical plane **120**. Alternatively, the second axis **148** may be offset anywhere relative to the first axis **144**. Additionally, the second axis **148** may be aligned and collinear with the first axis **144** such that the outer and inner rollers **68**, **72** rotate about the same generally horizontal axis.

Operation of the agricultural device **20** will now be described. With continued reference to FIGS. **1-3**, the agricultural device **20** is adapted to be pulled through a crop field for removal of remnant crop stalks **28** from the crop field. The lift mechanism **48** lowers the roller assembly **44** to an operating position, in which the bottom of the outer roller **68** engages the soil **32**. In this position, the bottom of the outer roller **68** is positioned below the bottom of the travel wheel **52**. Alternatively, the bottom of the outer roller **68** may be spaced above the soil **32**, but low enough to engage the remnant stalks **28**. The tractor **24** or other agricultural implement pulls the device **20** through a crop field. As the device **20** is pulled, the outer roller **68** rolls along the soil **32** (in a clockwise direction as illustrated in FIG. **1**) and the remnant crop stalks **28** insert into the openings **124** between the engagement members **104**. The remnant stalks **28** engage the exterior surface **132** of the inner roller **72**, begin to bend over as the outer roller **68** rolls along the soil **32**, and are pinched or compressed between the exterior surface **132** of the inner roller **72** and the inner edge **112** or teeth **116** of the engagement members **104**. This pinching occurs at a pinch point **152**. The teeth **116** assist with gripping, biting, puncturing, or otherwise deteriorating the remnant stalks **28**. The engagement between the exterior surface **132** of the inner roller **72** and the stalks **28** and inner edges **112** of the engagement members **104** also rotate the inner roller **72** (in a clockwise direction as illustrated in FIG. **1**). As the outer roller **68** continues to rotate along the soil **32**, the inner roller **72** rotates with the outer roller **68** and continues to pinch the remnant stalks **28** between the two rollers **68**, **72**, thereby lifting the remnant stalks **28** from the soil **32** toward a rear of the roller assembly **44**. Due to the size difference between the outer and inner rollers **68**, **72**, the exterior surface **132** of the inner roller **72** begins to be spaced-apart from the inner edges **112** of the engagement members **104** rearward of the pinch point **152**. This spacing no longer provides compression or pinching to the remnant stalks **28** pulled from the soil **32** by the roller assembly **44**. Thus, the remnant stalks **28** are released by the roller assembly **44** and fall back to a surface of the soil **32** behind the roller assembly **44**. By positioning the pinch point **152** to a rear of the ground contact point of the outer roller **68**, a natural lifting and pulling motion is created as the outer roller **68** rolls over the ground and the stalk **28** remains pinched between the outer and inner rollers **68**, **72**. This lifting and pulling motion provides for minimal soil **32** disruption.

During removal of the remnant stalks **28**, the stalks **28** are also crushed, splintered, or otherwise deteriorated between the inner roller **72** and the inner edges **112** and teeth **116** of the engagement members **104**. Crushing, splintering, and other forms of deteriorating remnant stalks **28** accelerate decomposition of the stalks **28**.

Referring now to FIG. **4**, another exemplary embodiment of the roller assembly **44**A is illustrated. The roller assembly

44A includes similarities to the roller assembly **44** illustrated in FIGS. **1-3** and such similarities are identified with the same reference number and an "A".

In this exemplary embodiment, the roller assembly **44**A includes a pair of biasing members **156** adapted to bias the inner roller **72**A against the inner edges **112**A of the engagement members **104**A. As the device **20**A is pulled over a crop field, the terrain is usually not perfectly flat and more likely is going to include rocks, uneven soil, tire ruts, trenches, or other types of height changes in the terrain. As the outer roller **68**A travels over these items, the outer roller **68**A is jarred or otherwise receives shocks or forces applied thereto, which may force the inner roller **72**A out of engagement with the inner edges **112**A of the engagement members **104**A. However, the biasing members **156** apply an opposing biasing force to the inner roller **72**A to assist with ensuring consistent and reliable contact between the exterior surface **132**A of the inner roller **72**A and the inner edges **112**A of the engagement members **104**A. The biasing members **156** may be any type of biasing member such as, for example, hydraulic devices, pneumatic devices, mechanical devices (e.g., metal spring or other biasing member), etc. A biasing member **156** may be positioned on each end of the roller assembly **44**A between the outer roller axle **96**A and the inner roller axle **136**A. Alternatively, the biasing members **156** may be coupled between the outer and inner rollers **68**A, **72**A in any manner and all of such possibilities are intended to be within the spirit and scope of the present disclosure.

With reference to FIG. **6**, another exemplary agricultural device **20**B is illustrated. The agricultural device **20**B includes similarities to the agricultural devices **20**, **20**A illustrated in FIGS. **1-5** and such similarities are identified with the same reference number and a "B".

The agricultural device **20**B includes a frame **36**B, a roller assembly **44**B and a travel wheel **52**B. The frame **36**B includes a hitch or coupling member **40**B at a front thereof and the travel wheel **52**B coupled to a rear thereof. The roller assembly **44**B is rotatably coupled to the frame **36**B between the hitch **40**B and the travel wheel **52**B. The roller assembly **44**B is similar in structure and function to the roller assembly **44** illustrated in FIGS. **1-3**, except the roller assembly **44**B illustrated in FIG. **6** is not coupled to a lift mechanism. Rather, the roller assembly **44**B illustrated in FIG. **6** is a generally vertically fixed relative to the frame **36**B by having an outer roller axle **96**B coupled to the frame **36**B.

The device **20**B includes a travel wheel arm **160** rotatably coupled to the frame **36**B and the travel wheel **52**B is rotatably coupled to the travel wheel arm **160** via a travel wheel axle **164**. The device **20**B also includes a lift mechanism **168** coupled between the frame **36**B and the travel wheel arm **160** for vertically moving the travel wheel **52**B. The lift mechanism **168** can be wide variety of different types of mechanisms adapted to vertically move the travel wheel **52**B. In the illustrated exemplary embodiment, the lift mechanism **168** includes a cylinder **172** coupled to the frame **36**B and a piston arm **176** coupled to the travel wheel arm **160** and moveable within and along the cylinder **172**. The piston arm **176** may be powered for movement in a variety of different manners, all of which are intended to be within the spirit and scope of the present disclosure. For example, the piston arm **176** may be driven by hydraulics, pneumatics, screw drive, or any other type of power capable of moving the piston arm **176** relative to the cylinder **172**. The lift mechanism **168** is adapted to move the travel wheel **52**B from a first position, in which the travel wheel **52**B engages the soil **32**B and elevates the roller assembly **44**B above the soil **32**B, to a second position, in which the travel wheel **52**B is moved upward out of engagement with the soil **32**B and the roller assembly **44**B is allowed to contact the soil **32**B. When the roller assembly **44**B is not is use and/or is traveling on surfaces other than crop fields, it may be desirable to have the travel wheel **52**B contact the ground surface instead of the roller assembly **44**B. This inhibits the roller assembly **44**B from prematurely wearing out or being damaged. In the illustrated exemplary embodiment, the device **20**B includes a single travel wheel **52**B and associated components. In other embodiments, the device **20**B includes a plurality of travel wheels **52**B and associated components to facilitate use of the plurality of travel wheels **52**B.

Referring now to FIG. **7**, yet another exemplary agricultural device **20**C is illustrated. The agricultural device **20**C includes similarities to the agricultural devices **20**, **20**A, **20**B illustrated in FIGS. **1-6** and such similarities are identified with the same reference number and a "C".

The roller assembly **44**C of this agricultural device **20**C includes an outer roller **68**C and a plurality of inner rollers **180**. The outer roller **68**C is rotatably coupled to the frame **36**C by a roller axle **184** and the inner rollers **180** are rotatably coupled to a support member **188**. The positions of the plurality of inner rollers **180** may be independently adjusted relative to the support member **188** to accommodate crop field conditions, treatment of the remnant crop stalks **28**C, and/or wear of the components of the roller assembly **44**C. In the illustrated exemplary embodiment, the support member **188** is rigidly fixed to the frame **36**C, thereby preventing rotation of the support member **188** relative to the frame **36**C. In other exemplary embodiments, the support member **188** is also rotatably coupled to the frame **36**C with the roller axle **184**.

The plurality of inner rollers **180** are substantially smaller than the outer roller **68**C in this illustrated embodiment and are also substantially smaller than the inner roller **72**, **72**A, **72**B of other embodiments illustrated and described herein. The plurality of rollers **180** are rotatably coupled near an outer edge **192** of the support member **188** and are incrementally positioned closer to inner edges **112**C of the engagement members **104**C until at least one of the rollers **180**, near the rear of the roller assembly **44**C, contact the inner edges **112**C of the engagement members **104**C. This contact between the inner edges **112**C of the engagement members **104**C and at least one of the inner rollers **180** creates a pinch point **152**C similar to the pinch point **152** described above in connection with the agricultural device **20** illustrated in FIGS. **1-3**.

During operation, the outer roller **68**C rolls along the top of the soil **32**C, the support member **188** remains fixed relative to the outer roller **68**C, and the remnant stalks **28**C insert into the openings **124**C defined between the engagement members **104**C and engage the plurality of rollers **180**. The stalks **28**C are bent over and ultimately pinched between at least one of the inner rollers **180** and inner edges **112**C of the engagement members **104**C. Continued rotation of the outer roller **68**C along the soil **32**C and the pinching of the stalks **28**C pull the remnant stalks **28**C from the soil **32**C. The remnant stalks **28**C are released after they pass the rearmost inner roller **180** and fall back to the surface of the soil **32**C for decomposition.

It should be understood that the agricultural devices of the present disclosure are capable of including devices other than the inner rollers illustrated and described herein to pinch or compress remnant stalks against the inner edges of the engagement members. For example, the agricultural devices may include a non-rotating fixed shoe positioned in the outer roller to provide a pinch point similar to the other embodiments. The shoe includes a curved front surface that leads into the pinch point to guide the remnant stalks toward and into the pinch point. The shoe may also include a curved rear surface behind the pinch point to provide for release of the stalks after

they are pulled from the soil. The shoe may provide the pinch point at a similar rear position as the other embodiments, or may provide the pinch point at any other location. Since the shoe will be fixed relative to the outer roller and will contact the inner edges of the engagement members, the shoe may include an engagement surface made of a material adapted to handle such repeated engagement. For example, the shoe may be made of ultra-high molecular weight (UHMW) plastic, HDPE, polypropylene, "rhino hide", various other types of plastic, various types of rubber, or any resilient material capable of withstanding such conditions.

In the illustrated exemplary embodiments included herein, the outer roller of the roller assembly contacts the soil or ground surface. It should be understood that the outer roller can be positioned above and out of contact with the soil during operation, but still engage remnant crop stalks to remove the stalks from the soil. The outer roller may be positioned above the soil in a variety of different manners. In one embodiment, the frame may be configured to support the outer roller above the soil. In another embodiment, the lifting mechanism can lift and hold the outer roller above the soil during operation. In still another embodiment, the travel wheel and associated lift mechanism can engage the soil to lift and support the outer roller above the soil. A variety of other manners exist for positioning the outer roller above and out of contact with the soil during operation and all of such possibilities are intended to be within the spirit and scope of the present disclosure.

The illustrated exemplary embodiments herein also disclose the engagement of the outer roller with the soil and remnant crop stalks as the driving force for rotating the outer and inner rollers. It should be understood that the agricultural device may include one or more drive mechanisms coupled to one or both of the inner and outer rollers to rotate the rollers during operation of the agricultural device. The drive mechanisms may be any type of drive mechanism.

It should be understood that the agricultural devices disclosed herein provide a benefit of not requiring precise alignment with rows of remnant stalks. Rather, the agricultural devices are merely pulled across the crop field and any row of remnant crop stalk positioned within the width of the roller assembly will be removed from the soil. This makes it easier for the operator to operate the agricultural devices, which decreases the amount of time required to remove remnant crop stalks.

It should also be understood that the use of any orientation or directional terms herein such as, for example, "top", "bottom", "front", "rear", "back", "left", "right", "side", etc., is not intended to imply only a single orientation of the item with which it is associated or to limit the present disclosure in any manner. The use of such orientation or directional terms is intended to assist with the understanding of principles disclosed herein and to correspond to the exemplary orientation illustrated in the drawings. For example, the agricultural devices may be utilized in any orientation and use of such terms is intended to correspond to the exemplary orientation of the agricultural devices illustrated in the drawings. The use of these terms in association with the agricultural devices is not intended to limit the agricultural devices to a single orientation or to limit the agricultural devices in any manner.

The Abstract of the Disclosure is provided to allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description, it can be seen that various features are grouped together in various embodiments for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed embodiments require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter lies in less than all features of a single disclosed embodiment. Thus the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separately claimed subject matter.

While various embodiments of the invention have been described, it will be apparent to those of ordinary skill in the art that other embodiments and implementations are possible within the scope of the invention.

The invention claimed is:

1. An agricultural device comprising:
- a frame including a hitch; and
- a roller assembly coupled to the frame, the roller assembly including
  - an outer roller including a pair of end plates and a plurality of spaced-apart engagement members extending between and coupled to the end plates, wherein each of the engagement members including an inner edge extending into the outer roller, and wherein the outer roller is rotatably coupled to the frame, and
  - an inner roller positioned in the outer roller and including a pair of end plates and an exterior surface extending between the end plates, wherein the inner roller is rotatably coupled to the outer roller and the inner edges of the engagement members are adapted to be positioned proximate the exterior surface of the inner roller;
- wherein the inner edges of the engagement members are at least partially serrated.

2. The agricultural device of claim **1**, wherein the inner edges of the engagement members engage the exterior surface of the inner roller.

3. The agricultural device of claim **2**, wherein the inner edges of the engagement members engage the exterior surface of the inner roller toward a rear of the roller assembly.

4. The agricultural device of claim **1**, further comprising a lift mechanism coupled to the frame and the roller assembly to vertically move the roller assembly.

5. The agricultural device of claim **4**, wherein the lift mechanism moves the roller assembly between an operating position, in which the outer roller engages soil, and an inoperative position, in which the outer roller is positioned above and out of contact with the soil.

6. The agricultural device of claim **1**, further comprising a travel wheel rotatably coupled to the frame and adapted to engage a ground surface.

7. The agricultural device of claim **6**, further comprising a lift mechanism coupled to the travel wheel to move the travel wheel vertically into and out of contact with a ground surface.

8. The agricultural device of claim **1**, wherein a position of the inner roller is adjustable relative to the outer roller.

9. An agricultural device comprising:
- a frame including a hitch; and
- a roller assembly coupled to the frame, the roller assembly including
  - an outer roller including a pair of end plates and a plurality of spaced-apart engagement members extending between and coupled to the end plates, wherein each of the engagement members including an inner edge extending into the outer roller, and wherein the outer roller is rotatably coupled to the frame, and
  - an inner roller positioned in the outer roller and including a pair of end plates and an exterior surface extending between the end plates, wherein the inner roller is rotatably coupled to the outer roller and the inner

edges of the engagement members are adapted to be positioned proximate the exterior surface of the inner roller;

wherein the exterior surface of the inner roller is at least partially made of a resilient material.

10. The agricultural device of claim **9**, wherein a position of the inner roller is adjustable relative to the outer roller.

11. An agricultural device comprising:

a frame including a hitch; and

a roller assembly coupled to the frame, the roller assembly including

an outer roller including a pair of end plates and a plurality of spaced-apart engagement members extending between and coupled to the end plates, wherein each of the engagement members including an inner edge extending into the outer roller, and wherein the outer roller is rotatably coupled to the frame, and

an inner roller positioned in the outer roller and including a pair of end plates and an exterior surface extending between the end plates, wherein the inner roller is rotatably coupled to the outer roller and the inner edges of the engagement members are adapted to be positioned proximate the exterior surface of the inner roller;

wherein the outer roller rotates about a first axis and the inner roller rotates about a second axis offset from the first axis; and

wherein the second axis is positioned below and to a rear of the first axis based on a direction of travel of the agricultural device.

12. The agricultural device of claim **11**, wherein a position of the second axis is adjustable relative to the first axis.

13. An agricultural device comprising:

a frame including a hitch; and

a roller assembly coupled to the frame, the roller assembly including

a first roller defining an internal cavity and including at least one engagement member, wherein the engagement member includes an inner edge extending into the internal cavity of the first roller, and wherein the first roller has a first diameter and is rotatably coupled to the frame, and

a second roller at least partially positioned in the internal cavity of the first roller and including an exterior surface, wherein the first roller is rotatably coupled to the second roller and the inner edge of the engagement member is adapted to be positioned proximate the exterior surface of the second roller, and wherein the second roller has a second diameter smaller than the first diameter;

wherein the first roller rotates about a first axis and the second roller rotates about a second axis offset from the first axis; and

wherein the second axis is positioned below and to a rear of the first axis based on a direction of travel of the agricultural device.

14. The agricultural device of claim **13**, wherein the first roller includes a plurality of engagement members and each of the plurality of engagement members include an inner edge, and wherein inner edges of the plurality of engagement members are adapted to be positioned proximate the exterior surface of the second roller.

15. The agricultural device of claim **13**, wherein the inner edge of the engagement member is at least partially serrated.

16. The agricultural device of claim **13**, wherein the inner edge of the engagement member engages the exterior surface of the second roller.

17. The agricultural device of claim **16**, wherein the inner edge of the engagement member engages the exterior surface of the second roller toward a rear of the roller assembly.

18. The agricultural device of claim **13**, wherein the exterior surface of the second roller is at least partially made of a resilient material.

19. The agricultural device of claim **13**, wherein the second roller is one of a plurality of second rollers, wherein each of the plurality of second rollers include an exterior surface that is adapted to be positioned proximate the inner edge of the engagement member.

20. The agricultural device of claim **13**, wherein a position of the second axis is adjustable relative to the first axis.

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